TRUE / FALSE TEST # 3

___ 1. The clam is cold blooded.

___ 2. The clam has one valve.

___ 3. A relative of the clam is the oyster.

___ 4. The clam gets its food by catching it with its valves.

___ 5. The clam has one adductor muscle.

___ 6. Part of the intestine goes through the foot.

___ 7. The brain is connected to the visceral and foot ganglia.

___ 8. Waste material is expelled by using the foot.

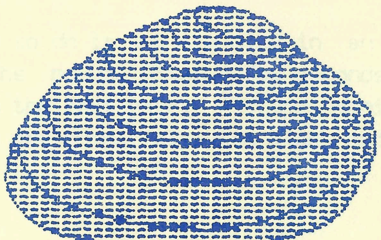
___ 9. The largest organ in the respiratory system is the gill.

___10. The baby clams are called pupae.

APPLE

COMPUTER BIOLOGY LAB

CLAM



CROSS EDUCATIONAL SOFTWARE

CLAM
DISSECTION

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Larry Newby

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Phone 318-255-8921

INTRODUCTION

"CLAM DISSECTION" can be used as a pre-lab or post-lab computer activity. It gives instructions and definitions that a student should know before entering the lab. After a dissection the program can be used as a self-test. The reading level and content are meant for seventh and tenth grade biology students.

GETTING STARTED

All you have to do is put the disk in an Apple computer and turn on the power. After a few seconds the screen will show the menu on the next page. A color monitor will help, but the pictures are compatible with black and white.

COPIES

This disk is protected against being copied. A backup disk is included in case of accident. If the disk doesn't run when you receive it, it will be replaced free. Just mail it back to Cross Educational Software. If the disk fails after being used for 30 days, it could be due to mishandling, such as a scratch or a fingerprint. After 30 days there is a $6 charge to replace a disk.

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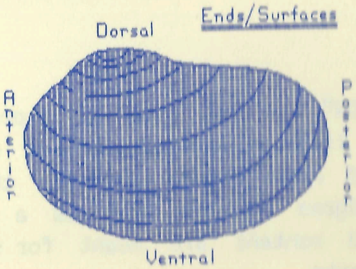
MANUAL AND TESTS

The following pages are a summary of the program. The test pages can be duplicated and given to students if there isn't enough time for all students to run the program during class.

MAIN MENU

1) ORIENTATION
2) STRUCTURES AND FUNCTIONS
3) SELF TEST
4) STUDENT CONTROLLED DISSECTION



1) ORIENTATION: VOCABULARY LIST

- ADDUCTOR MUSCLE
- ANTERIOR
- ANUS
- BRAIN
- CEREBRAL GANGLIA
- CILIA
- DIGESTIVE GLAND
- DORSAL
- ESOPHAGUS
- EXCURRENT SIPHON
- EXOSKELETON
- FOOT
- FOOT GANGLIA
- GILL
- GLOCHIDIUM
- GONAD
- HEART
- INCURRENT SIPHON
- INTESTINE
- INVERTEBRATE
- KIDNEY
- LINES OF GROWTH
- MANTLE
- MOLLUSK
- MOTHER OF PEARL
- MOUTH
- NACRE
- NERVE CORD
- OPEN SYSTEM
- PALP
- PARASITE
- PERICARDIUM
- POSTERIOR
- RECTUM
- STOMACH
- UMBO
- VALVES
- VENTRAL
- VISCERAL GANGLIA
- VISCERAL MASS
- ZYGOTE

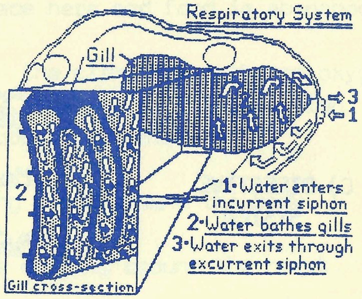
GENERAL BACKGROUND

The clam is an invertebrate. This means it has no backbone. It is also a mollusk. That means it has a protective shell that covers and protects a soft visceral mass. The clam is a bivalve. It has two distinct halves or valves that make up its shell. These valves are connected between the dorsal and ventral surfaces. Although it might not be very obvious, the clam does have an anterior end and posterior end. It also has a dorsal and ventral side.

It lives at the bottom of a lake or stream with its anterior end buried in the sand or mud. The clam anchors itself by extending its foot into the bottom and then expanding it. This provides a good base that will not allow the clam to be removed easily. The clam lives out its life filtering tiny plants and animals from the water. Some of the clam's close relatives include snails, squids, oysters, and the octopus.

2) DEFINITIONS OF STRUCTURES

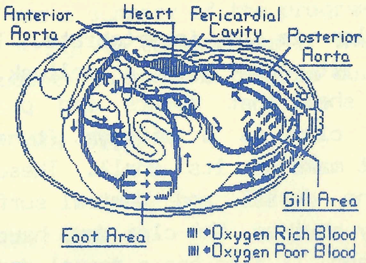
A) RESPIRATORY SYSTEM



Respiratory System
Gill
3
1
2
1·Water enters incurrent siphon
2·Water bathes gills
3·Water exits through excurrent siphon
Gill cross-section

GILLS - Breathing structures in the clam that exchange oxygen and carbon dioxide. They also aid in the operation of the digestive and reproductive systems.

B) CIRCULATORY SYSTEM



Circulatory System

HEART - Organ responsible for pumping blood around the body.

FOOT AREA - Area in foot where oxygen is supplied to cells and carbon dioxide is removed.

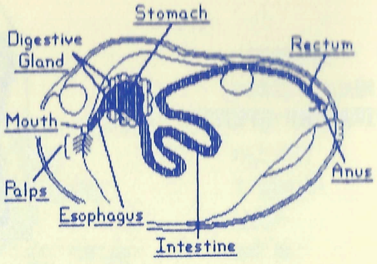
PERICARDIAL CAVITY - Opening around the heart.

ANTERIOR AORTA - Main artery running along the dorsal surface from the heart toward the anterior end.

GILL AREA - Area where carbon dioxide is exchanged for oxygen.

POSTERIOR AORTA - Main artery running from the heart toward the posterior end along the dorsal surface.

C) DIGESTIVE SYSTEM



Digestive System

MOUTH - Opening to digestive system near anterior of visceral mass.

STOMACH - Storage area for food. Some digestion takes place here.

PALPS - Cilia covered structures that collect food from the gills and transfer it to the mouth.

ESOPHAGUS - Tube that carries food from the mouth to the stomach.

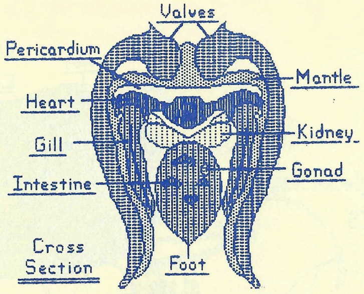
INTESTINE - More digestion takes place here, and the food is absorbed.

DIGESTIVE GLAND - exact function not known. May secrete digestive enzymes to help digestion.

ANUS - Opening at posterior that is used for the elimination of waste.

RECTUM - Last section of intestine. Waste is stored here before removal.

D) CROSS SECTION



INTESTINE - More digestion takes place here and food is absorbed.

GILLS - Breathing structures in the clam that exchange oxygen and carbon dioxide. They also aid in the operation of the digestive and reproductive systems.

HEART - Organ responsible for pumping blood around the body.

PERICARDIUM - Lining surrounding the opening around the heart.

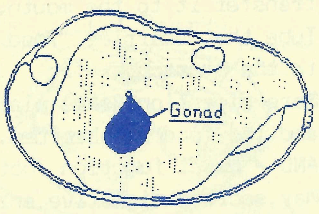
VALVES - Protective outer exoskeleton. Also known as shells.

MANTLE - Lining between the valves and the visceral mass. Secretes shell building material.

KIDNEY - Filters waste material from the blood.

GONAD - Reproductive organ of clam. TESTIS (Testes- plural) in the male, OVARY in the female.

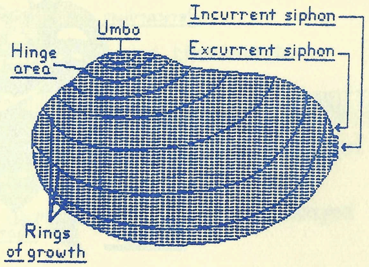
E) REPRODUCTIVE SYSTEM



Reproductive System

GONAD - Reproductive organ of the clam.
TESTIS in male; OVARY in female.

F) EXTERNAL FEATURES



HINGE AREA - Located on dorsal surface. Holds valves together.

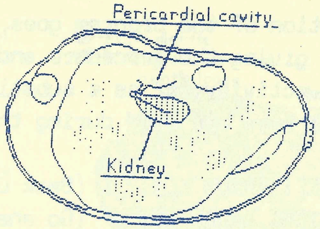
UMBO - Oldest part of valve. Most dorsal part of clam.

EXCURRENT SIPHON - Found at posterior. Exit for wastes. Found dorsal to the incurrent siphon.

INCURRENT SIPHON - Found at posterior. Intake for fresh water. Found ventral to the excurrent siphon.

LINES OF GROWTH - Lines arcing from anterior to posterior. Show periods of growth in the clam.

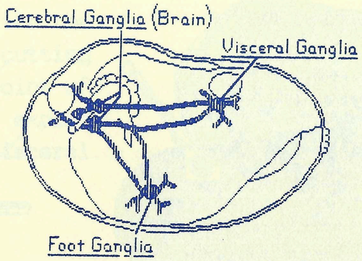
G) EXCRETORY SYSTEM



Excretory System

KIDNEY - Removes organic waste from the blood. Located near the center of the visceral mass.

H) NERVOUS SYSTEM



Nervous System

CEREBRAL GANGLIA - Enlarged ganglion found near the end of the visceral mass. Also called the brain.

FOOT GANGLIA - Group of nerve cells which controls nearby body parts.

VISCERAL GANGLIA - Group of nerve cells which controls nearby body parts.

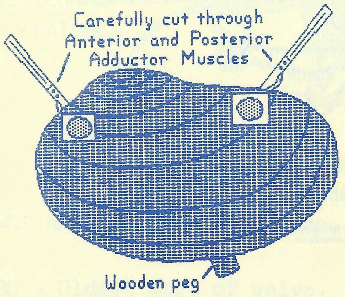
DISSECTION GUIDE

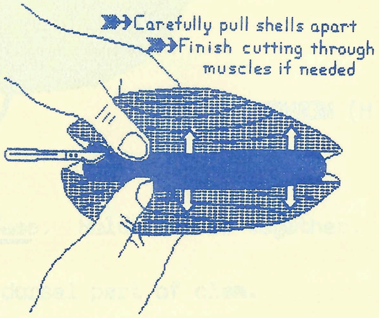
This section of the program goes through the steps of a clam dissection, giving the procedure and precautions. It can be used as a pre-lab activity, or as a substitute for a pre-lab lecture.

Only four keys are used during this section:

<--	LEFT ARROW KEY	(Back up a page.)
-->	RIGHT ARROW KEY	(Go ahead to the next page.)
'RTN'	RETURN KEY	(Switch between text and graphics.)
'ESC'	ESCAPE KEY	(Get out.)

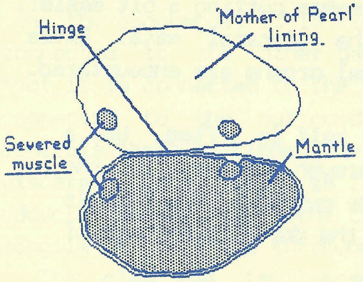
We shall begin our dissection of the clam by opening the two shells or valves. Insert your scalpel between the valves and cut through the anterior and posterior adductor muscles. See the picture for the approximate location. Most preserved specimens are supplied in a partially opened state. This is done by inserting a wedge between the valves so they are not able to close completely. This makes the task of cutting the adductor muscles easier.

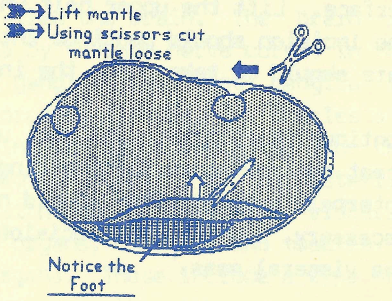

Carefully cut through Anterior and Posterior Adductor Muscles


➽Carefully pull shells apart
➽Finish cutting through muscles if needed

Once you feel the adductor muscles have been cut sufficiently, carefully pull the valves apart. If the muscles have not been cut properly, you may finish cutting through them at this time. You should be able to see them once the valves are partially opened.

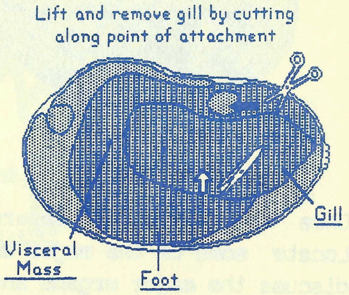
Once the muscles are cut, the valves should open quite easily. Notice how they are fastened together or hinged. Observe the skin-like mantle covering the main part of the clam. This mantle secretes a substance that forms the pearly lining of each valve. This forms a non-irritating surface for the very sensitive mantle. Observe the mother-of-pearl lining inside of each valve. At this point you may wish to remove one of the valves.



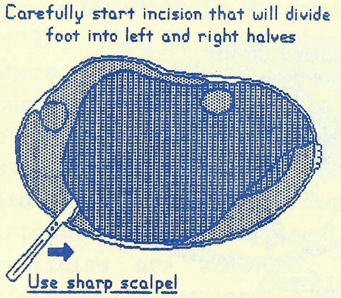

➽Lift mantle
➽Using scissors cut mantle loose

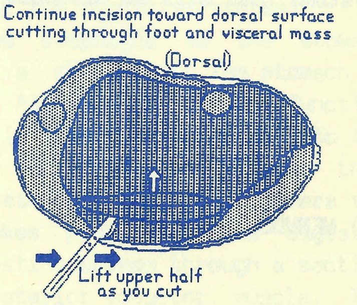
[illegible] le loose with your scissors at the point where it is attached. This will expose the foot, gill, and visceral mass.

Observe the placement of the gill and visceral mass. Lift the gill and remove it by cutting it loose at its point of attachment. This will expose the majority of the visceral mass.


Lift and remove gill by cutting along point of attachment

We shall now open the foot and visceral mass, exposing some of the internal organs. Using your scalpel, start an incision in the end of the foot. This incision should start to separate the foot into two equal halves.

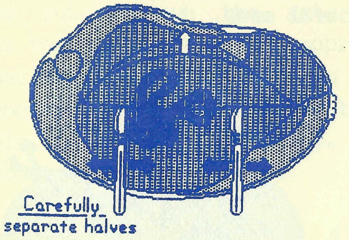

Carefully start incision that will divide foot into left and right halves


Continue incision toward dorsal surface cutting through foot and visceral mass

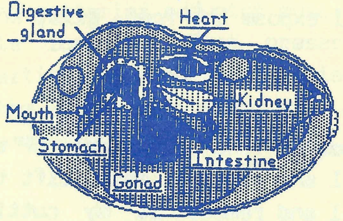
Continue the incision through the foot and toward the dorsal surface. Lift the upper half which makes cutting a bit easier. The incision should continue into the visceral mass. Extra care should be taken once the internal organs are encountered.

Continue the incision as the upper half is lifted. Use a great deal of care when cutting through the area of the internal organs. They should not be cut any more than is necessary. Continue the incision to the dorsal-most part of the visceral mass.

Cut more carefully as internal organs are encountered



With halves separated a number of organs may be studied

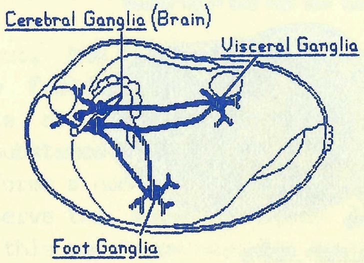


Once the halves are separated, you may carefully examine them. Locate some of the major organs. In the next section we shall discuss the major organs and systems in more detail.

DETAILS OF INTERNAL SYSTEMS

In this section of the program we shall take a closer look at several of the clam's internal systems and the functions of each. By using your dissected specimen for reference, you should be able to find and identify many of the structures and systems that will be discussed here.

1) NERVOUS SYSTEM

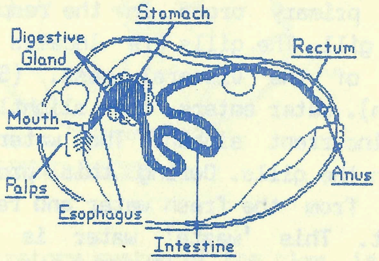


Nervous System

The nervous system of the clam is made up of three main bundles of nerve cells or ganglia. The cerebral ganglia is located near the esophagus. It is also called the brain. The brain is connected to the other ganglia by various nerve cords. In the foot it is connected to the foot ganglia. The foot ganglia is connected to the surrounding organs, tissues, and muscles and controls their funtions. The brain is also connected to the visceral ganglia which is located just ventral to the posterior adductor muscle. As is the case with foot ganglia, the visceral ganglia controls the surrounding organs, tissues, and muscles.

The clam has few sense organs. These include a type of chemical sensor found on the palps and the siphons, a touch receptor found along the mantle, and a temperature receptor also found on the mantle.

2) DIGESTIVE SYSTEM

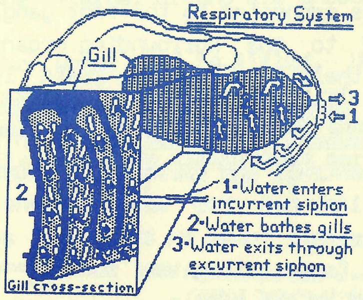


Digestive System

The food particles including small plants and animals are carried into the clam through the incurrent siphon. As the water passes over the gills, these small food particles are trapped by the sticky mucus which covers the gills. The surface of the gills are also covered with cilia or tiny hairs. These cilia move in a 'wave-like' motion carrying the food particles to the palps. The palps are folds of skin which are also covered with cilia. They collect the food from the gills and transfer it to the mouth which is the beginning of the digestive system.

The food is moved through the esophagus to the stomach where the food is stored for a short time. The stomach is surrounded by the digestive gland. Although the exact function of this organ is not known, it does have openings into the stomach and may secrete some type of digestive enzymes that aid in digestion. From the stomach the food enters the intestine where more digestion takes place and the digested particles are absorbed. The intestine passes through a section of the heart and loops over the posterior adductor muscle. The last section of the intestine is called the rectum. The wastes are stored here until they are eliminated through the anus. The wastes are then emptied in the 'waste' water coming from the gills and are swept out of the clam through the excurrent siphon.

3) RESPIRATORY SYSTEM

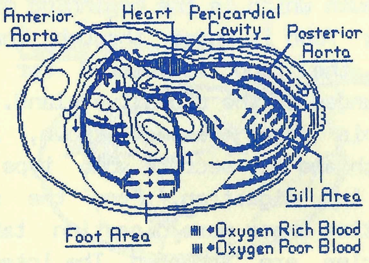

Gill
2
3
1
1-Water enters incurrent siphon
2-Water bathes gills
3-Water exits through excurrent siphon
Gill cross-section

Respiratory System

The primary organ in the respiratory system of the clam is the gill. The gills are located on the left and right sides of the visceral mass. (See General Features-Cross Section). Water enters the slightly opened valves through the incurrent siphon. The water is circulated over and through the gills. During this process the clam takes in oxygen from the fresh water and releases carbon dioxide back into it. This 'waste' water is then forced out of the excurrent siphon. While this is going on, the clam is also using its gills to collect food.

The gills are covered with tiny hair-like structures called cilia and a very sticky mucus. The mucus traps small plants and animals, and the cilia beating in a wave-like motion carry this food toward the mouth. The gills also function as a type of 'nursery' in the female. The eggs are fertilized as water carrying the sperm cells circulates through the gills. The fertilized eggs or zygotes are held in the gills until they are developed, and then expelled through the excurrent siphon.

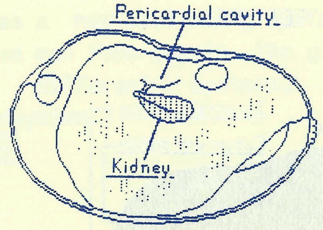
4) CIRCULATORY SYSTEM



Circulatory System

The circulatory system of the clam is an open system. This means that the blood is not always contained within the veins and arteries. In certain parts of the body, the blood leaves the arteries and 'bathes' the body cells. It later is 'pooled' back into the veins. The heart is surrounded by the pericardial cavity or percardium. The intestine passes through this cavity and the kidney also opens into it. The main blood vessels include the anterior and posterior aortas. They branch out into the clam servicing all of the major structures including the gills, foot, mantle, and adductors.

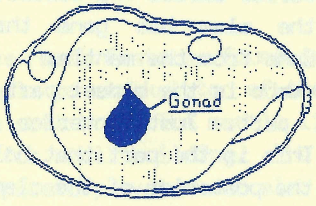
5) EXCRETORY SYSTEM



Excretory System

The main organ in the excretory system of the clam is the kidney. It is located just ventral to the heart area within the visceral mass. The kidney is responsible for removing wastes from the bloodstream. The wastes are eliminated later through the excurrent siphon.

6) REPRODUCTIVE SYSTEM



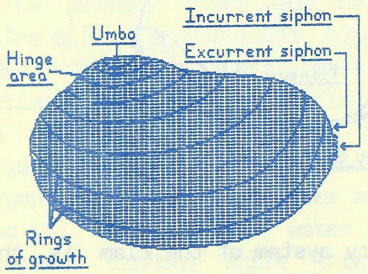
Reproductive System

The main organ in the reproductive system is the gonad. This organ looks much the same in the male and female. The sperm cells are produced in the testis or male gonad and are released into the water through the excurrent siphon. These sperm cells are carried into the female clam through the incurrent siphon.

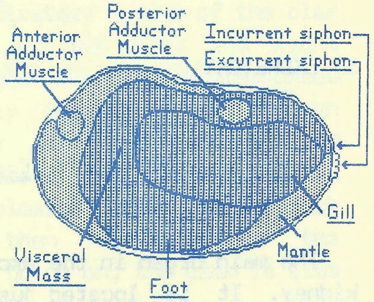
The eggs are released from the ovary or female gonad and held inside of the gills until they are fertilized by the sperm. The fertilized eggs or zygotes are held for a short time in the gills which function as a 'nursery'.

After a short growth period, the young clam or glochidium is ejected through the excurrent siphon into the environment. The glochidium attaches itself to a fish and lives for a time as a parasite getting its nourishment from the fish. It later drops off and starts its life as a bottom dweller.

7) EXTERNAL FEATURES



INTERNAL FEATURES



There are several external features to be found on the clam. The lines of growth can be seen to arc from anterior to posterior across the valves. They show periods of growth that the clam has gone through. These areas are added by secretions from the mantle.

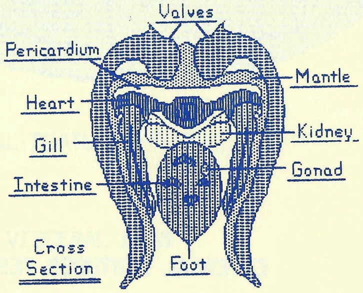
The umbo is the oldest part of the clam found on the most dorsal part. Just anterior to the umbo is found the hinge area. This is the part that holds the two valves together.

At the posterior of the clam you can see the incurrent and excurrent siphons. The incurrent siphon brings fresh water into the clam and is the most ventral of the two. The excurrent siphon is the way the 'waste' water goes out.

There are several internal features that may be observed after the clam is first opened. The anterior and posterior adductor muscles are attached to both the left and right valves. When contracted they make the clam almost impenetrable. At the posterior end you can find the two siphons. The incurrent siphon is the most ventral of the two and is where the fresh water enters. The excurrent siphon is where the 'waste' water leaves the clam.

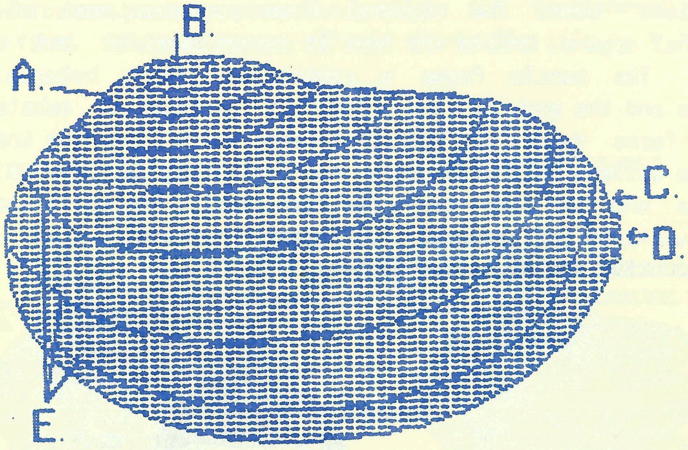
The foot and visceral mass almost appear to be as one. The foot is very muscular and is used for digging. By forcing the foot into the mud or sand, expanding the end, and shortening the length, the clam is able to pull itself into the bottom. The broadened foot also provides an excellent base. The visceral mass contains most of the internal organs. Unlike the foot it is not muscular but very soft. The mantle forms a protective lining between the valves and the body of the clam. It secretes a substance that forms nacre or mother-of-pearl which lines the inside of the valves. This provides a non-irritating surface for the mantle and in some cases can form pearls. The gills aid in the functions of several different systems. (See the Reproductive and Digestive System.)

CROSS SECTION



The cross section includes many features found in other systems. The valves are the shells or exoskeleton of the clam. They provide protection for the soft body. The mantle lines the valves and secretes substances for shell building. The gills are the main organ in the respiratory system and also aid in feeding and reproduction. The foot is a muscular organ used for digging and anchoring the clam. The heart is the main circulatory organ and is surrounded by an open space or pericardium. The intestine is the largest organ in the digestive system and is responsible for digestion and absorption. The kidneys are responsible for waste removal from the blood. The gonad is the ovary in the female and the testis in the male.

General External Features



EXTERNAL FEATURES TEST

___ 1. GROWTH LINES

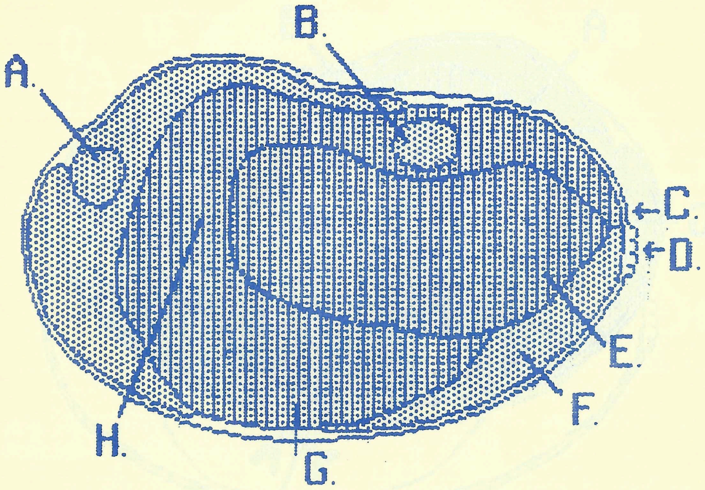
___ 2. HINGE AREA

___ 3. INCURRENT SIPHON

___ 4. EXCURRENT SIPHON

___ 5. UMBO

General Internal Features



INTERNAL FEATURES TEST

___ 1. VISCERAL MASS

___ 2. EXCURRENT SIPHON

___ 3. MANTLE

___ 4. ANTERIOR ADDUCTOR

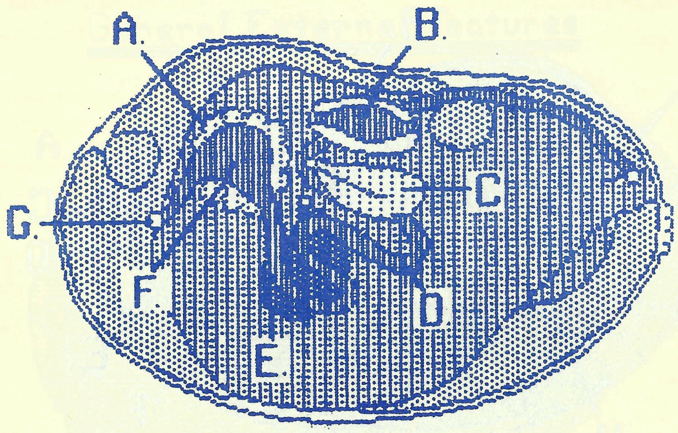
___ 5. FOOT

___ 6. INCURRENT SIPHON

___ 7. POSTERIOR ADDUCTOR

___ 8. GILL

General Internal Organs



INTERNAL ORGANS TEST

___ 1. KIDNEY

___ 2. MOUTH

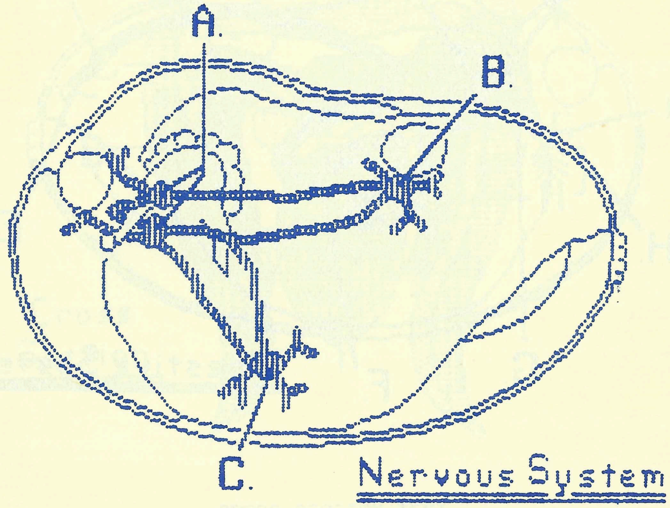
___ 3. INTESTINE

___ 4. HEART

___ 5. DIGESTIVE GLAND

___ 6. STOMACH

___ 7. GONAD



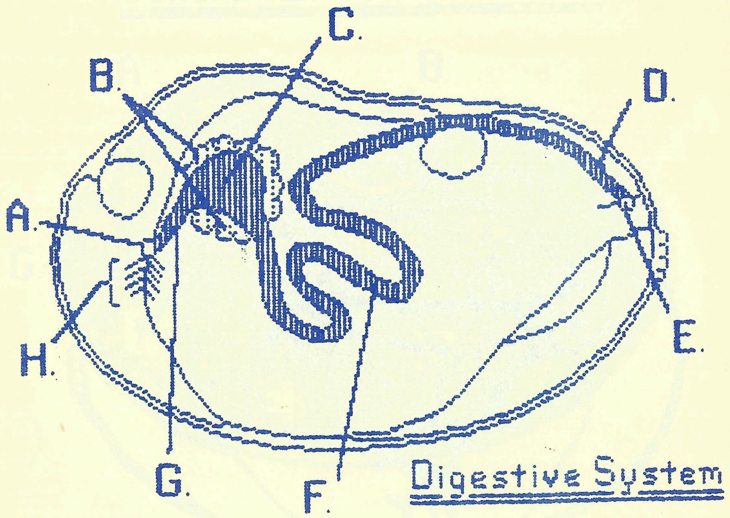
Nervous System

NERVOUS SYSTEM TEST

___ 1. VISCERAL GANGLIA

___ 2. CEREBRAL GANGLIA

___ 3. FOOT GANGLIA



DIGESTIVE SYSTEM TEST

___ 1. ANUS

___ 2. DIGESTIVE GLAND

___ 3. RECTUM

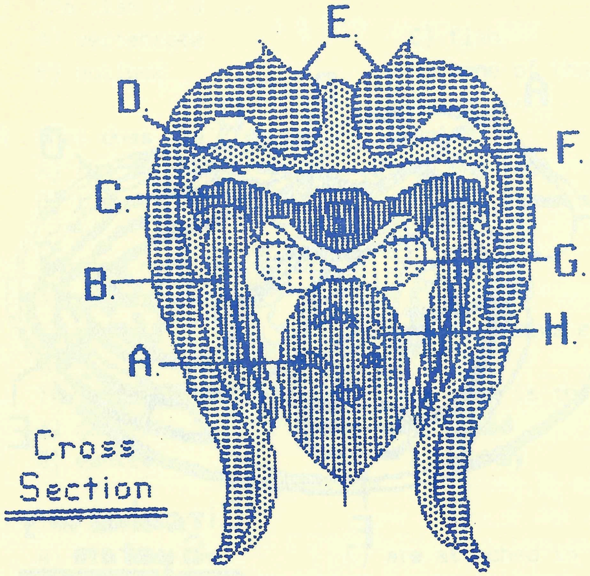
___ 4. ESOPHAGUS

___ 5. MOUTH

___ 6. STOMACH

___ 7. PALPS

___ 8. INTESTINE



CROSS SECTION TEST

___ 1. HEART

___ 2. VALVES

___ 3. GONAD

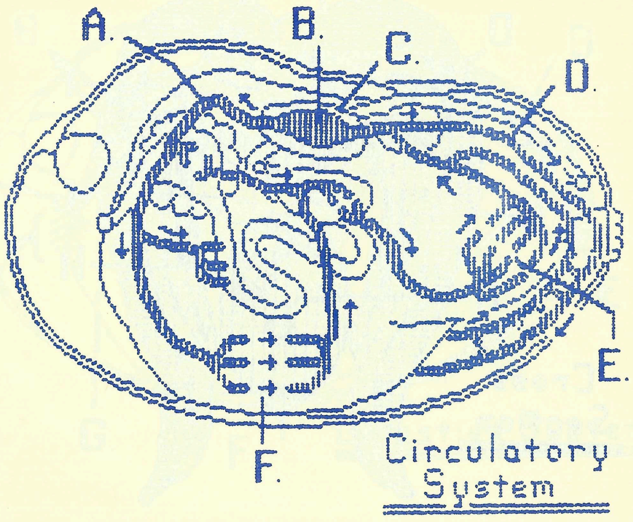
___ 4. KIDNEY

___ 5. INTESTINE

___ 6. PERICARDIUM

___ 7. MANTLE

___ 8. GILL



CIRCULATORY SYSTEM TEST

___ 1. POSTERIOR AORTA

___ 2. FOOT AREA

___ 3. HEART

___ 4. PERICARDIUM

___ 5. GILL

___ 6. ANTERIOR AORTA

MULTIPLE CHOICE TEST

___ 1) The clam is a ...
A) vertebrate C) fish
B) mollusk D) none of these

___ 2) What does the clam use for digging?
A) the valves C) the foot
B) the mantle D) the excurrent siphon

___ 3) Another name for NACRE is ...
A) mother-of-pearl C) cilia
B) mucus D) digestive enzyme

___ 4) The main excretory organ of the clam is the ...
A) gill C) gonad
B) mantle D) kidney

___ 5) The adductors ...
A) are muscles. C) are attached to the heart.
B) are the siphons. D) are part of the foot.

___ 6) The folds of skin near the mouth are the ...
A) valves C) palps
B) siphons D) cilia

___ 7) To find the siphons one should look at what part of the clam?
A) anterior C) dorsal
B) posterior D) ventral

___ 8) The gills of the clam aid in the function of the ...
A) reproductive system C) digestive system
B) respiratory system D) all of these

___ 9) The heart of the clam is surrounded by the ...
A) kidney C) pericardium
B) foot D) digestive gland

___ 10) The shell of the clam is made by the ...
A) foot C) umbo
B) siphons D) mantle

TRUE / FALSE TEST # 1

___ 1. The clam has an open circulatory system.

___ 2. The clam has two valves.

___ 3. A relative of the clam is the octopus.

___ 4. A clam gets its food by filtering it out of the water.

___ 5. The clam has three adductor muscles.

___ 6. Most of the clam's internal organs are found in the visceral mass.

___ 7. The ganglia control nearby muscles, organs, and tissues.

___ 8. Waste material is expelled through the excurrent siphon.

___ 9. The largest organ in the digestive system is the intestine.

___10. The baby clams are called glochidia.

TRUE / FALSE TEST # 2

___ 1. Clams have closed circulatory systems.

___ 2. The clam has three valves.

___ 3. The snail is a relative of the clam.

___ 4. A clam gets its food by digging it out of the mud.

___ 5. The clam has two adductor muscles.

___ 6. Most of the clam's internal organs are found in the foot.

___ 7. The brain controls the whole clam.

___ 8. Waste material is expelled through the incurrent siphon.

___ 9. The largest organ in the reproductive system is the gonad.

___10. The baby clams live part of their lives as parasites.